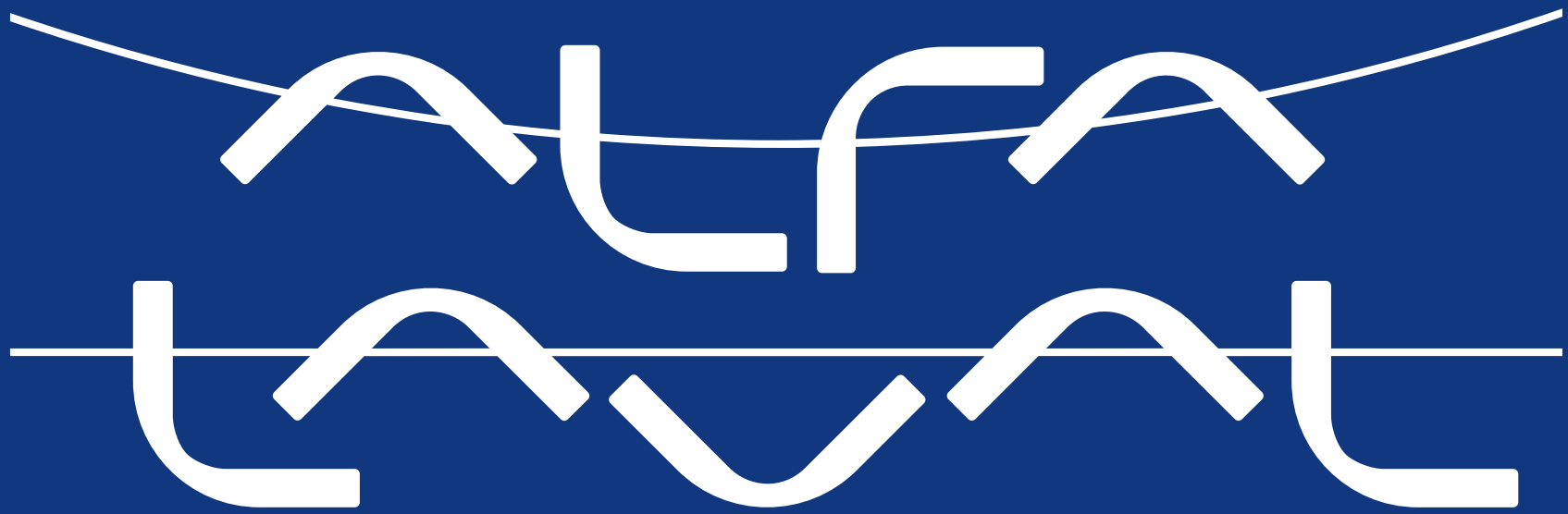
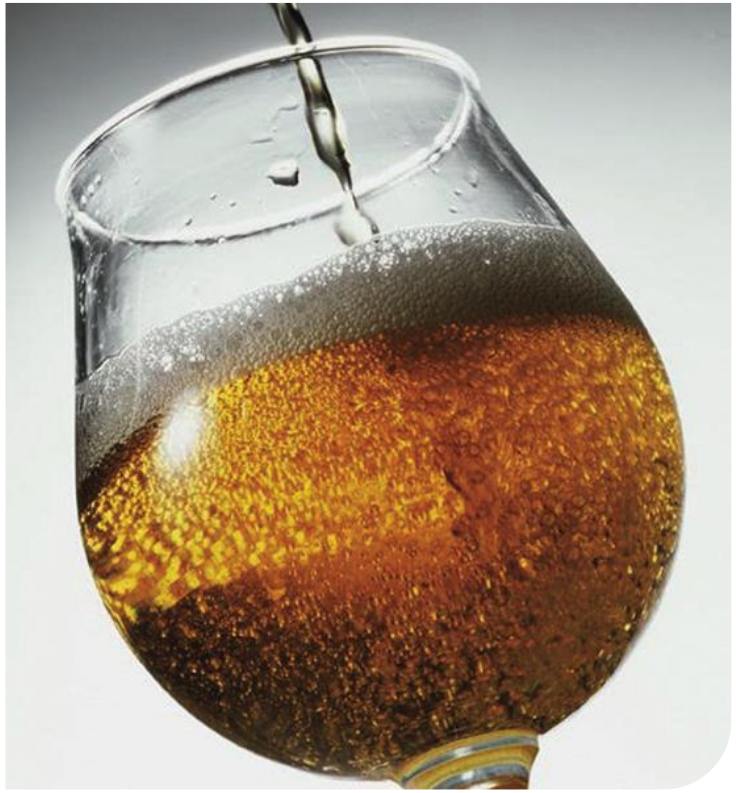

ALFA
LAVAL

How to scale up production with a Centrifuge

Joakim Gustafsson
Global Sales BU HSS
Tumba, Sweden

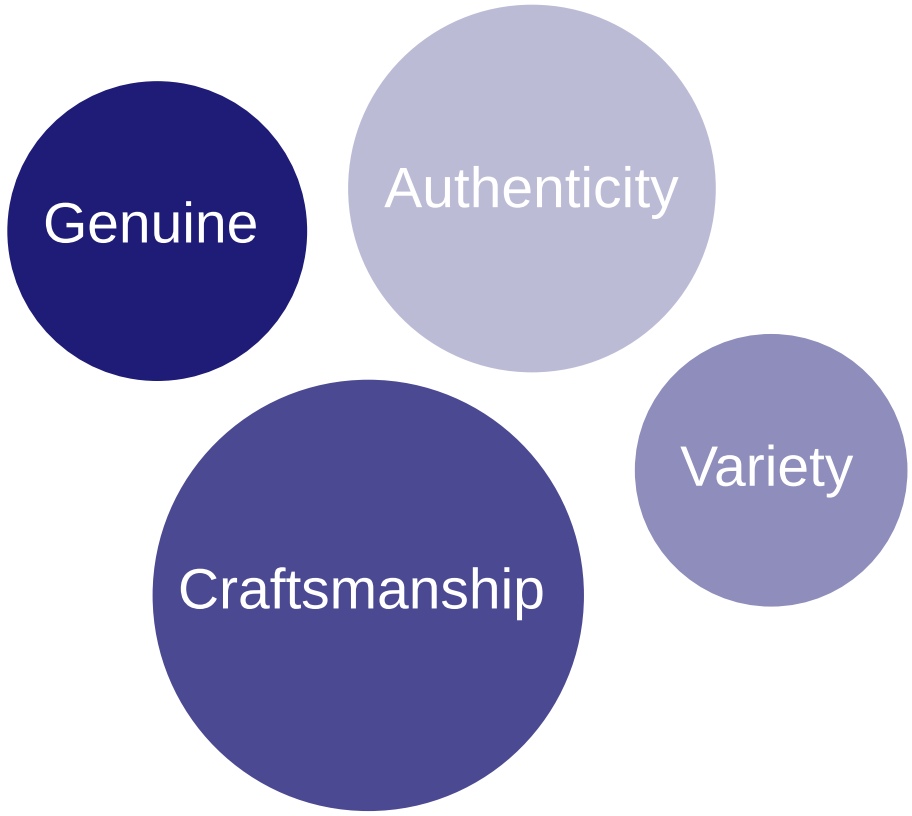
Agenda

- Background
  - Centrifuges in the brewery process
- Centrifuge technology & types of HSS
- Brewing applications
- Complete Brew HSS systems
  - Options
- Separation system as a tool to produce various beer styles
- Customer examples & the ROI calculator
- Q/A



Background

Craft



Industrial

Challenges for the growing craft beer market

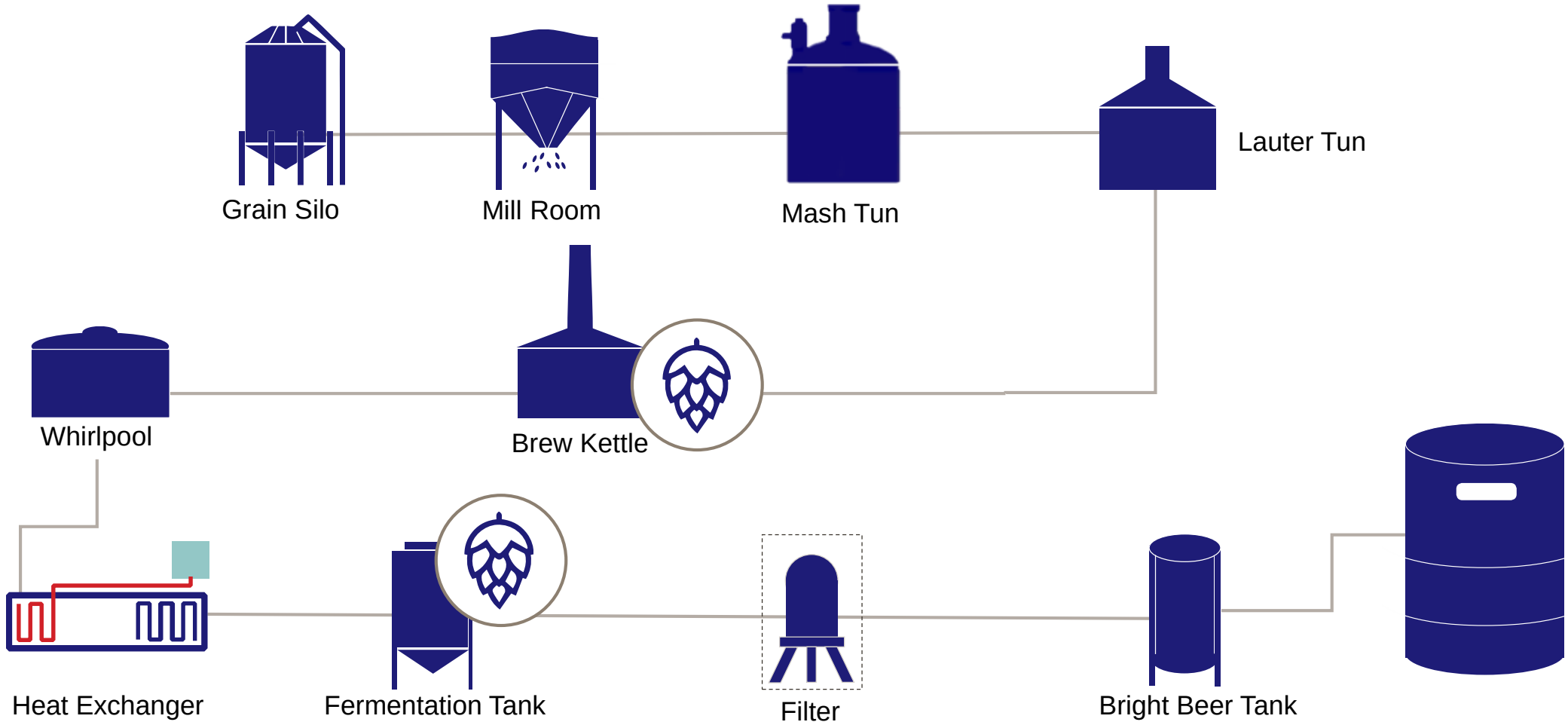
– Including for industrial breweries that are producing craft beer styles

Growing craft beer production means:

- Implement consistency of production and final beer
- Deal with multiple beer styles
- Keep beer losses under control
- Improving shelf-life

How can a centrifuge contribute to keeping my craft beer authentic while improving beer output?

General Brewing Process Layout



Filtration

Alternative or complimentary

- DE filters/Kiselguhr filters
- Lenticular and other dead-end filters
- Cross Flow Filters
- Combinations with centrifuge possible

Challenges of filtration

- Clogging
- Pressure loss
- Health risks
- Disposal costs
- DO pick up

Centrifuges in the brewery process

Centrifuges - a great tool for brewers

– Reasons to install a centrifuge

- Clarify beer – remove coarse solids and improve quality
  - Keep what you want
  - Final haze adjustment
- Allow brewers to use new ingredients and provide control of the contact time with beer
- Reduce beer losses
- Increase production capacity with the same number of tanks – reduce sedimentation time
- To replace a trap filter clogging regularly

Centrifuge Technology
& types of HSS

Separation technology today

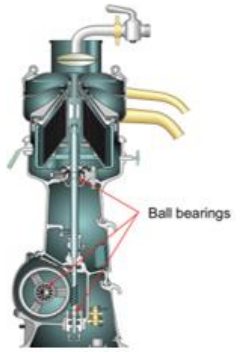
- High separation efficiency
- Minimum oxygen pick-up
- Low product losses
- Low power consumption

A History of Innovation

– The inventor of the continuous separator

The Alfa disc

1889

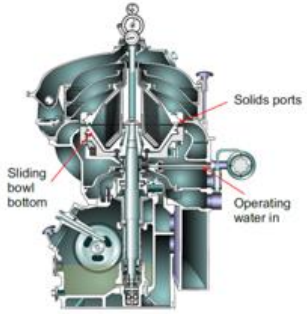


Ball bearings

1926

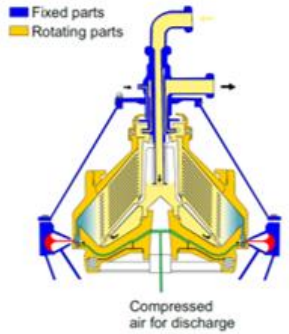
The hermetic seal

1933



The self ejecting separator (PX)

1953



Combined PX and X

1978

eDrive & eMotion

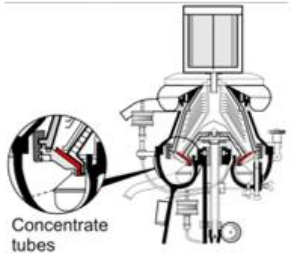
2009

1878

First continuous separator

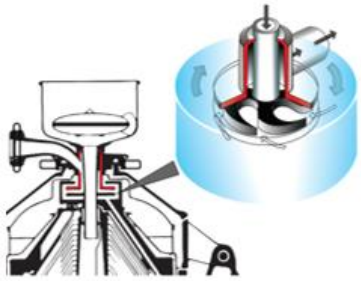
1897

The first nozzle machine



1935

The internal pump



1959

The hermetic PX

1990's

CentriZoom & Self triggering

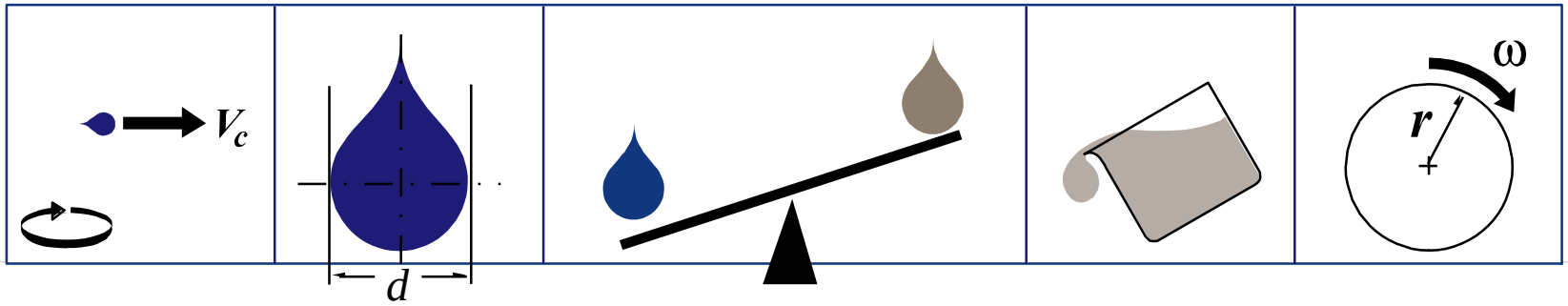
Centrifugal separation

– Accelerated settling

8000-13000 g
4000 – 10000 rpm

$$V_c = \frac{d^2(\rho_w - \rho_o)}{18\eta} r\omega^2$$

V_c	d^2	ρ_w	ρ_o	η	$r\omega^2$
centrifugal settling velocity (m/s)	Particle size (mm Ø)	particle density (kg/m**3**)	liquid density (kg/m**3**)	continuous phase viscosity (kg/ms)	centrifugal acceleration (m/s**2**)

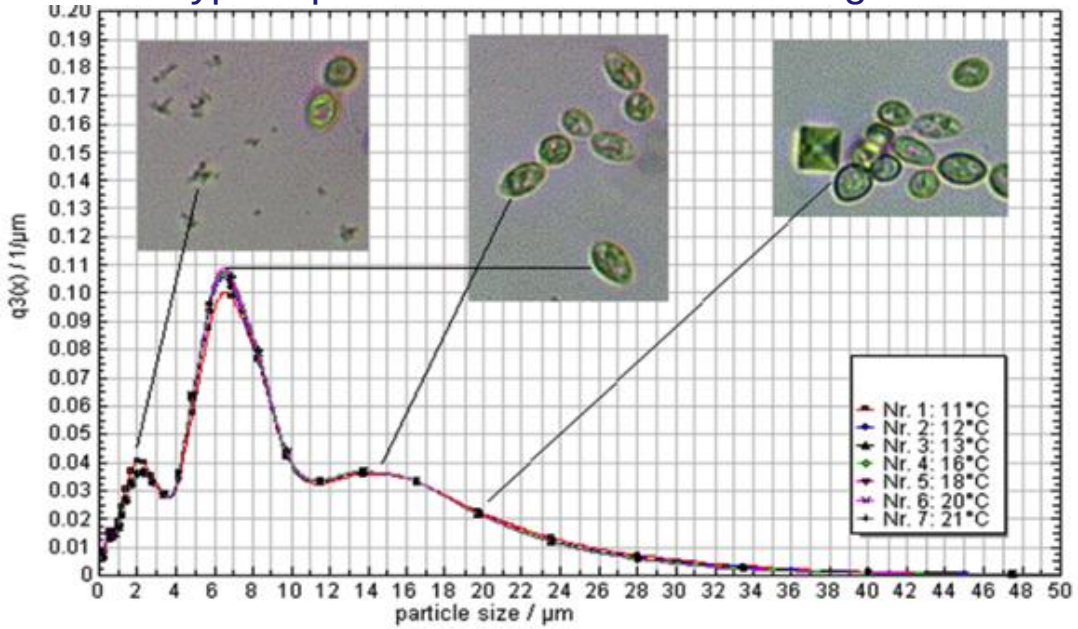


Avoiding particle micronization is key

It’s not a filter
is it a clarifier or polisher ?
in fact, it is a “classifier”

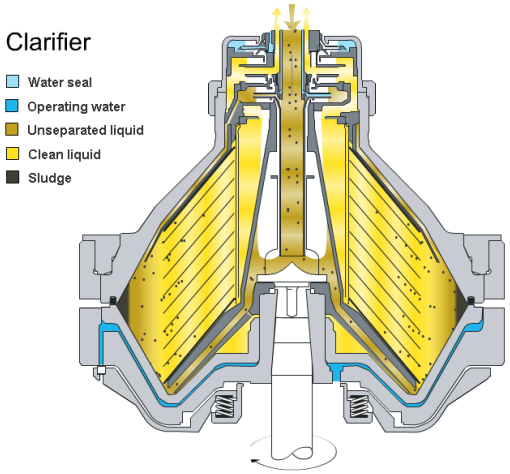
- Reduced flow
  - less large particles in the beer
- Increased flow
  - more large particles in the beer
- By-pass needed
  - for some hazy wheat beers

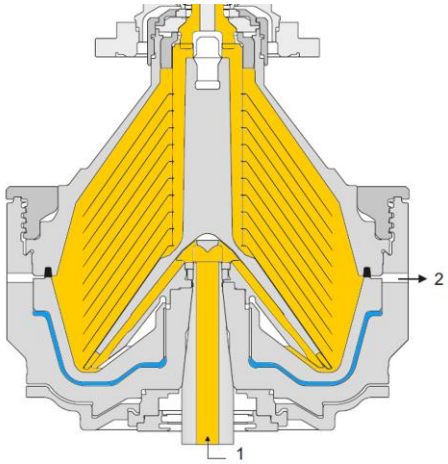
Typical particle size distribution in lager beer



Increased flow

Evolution of the feed system





Traditional top feed inlet

Fully hermetic Center to Center bottom feed inlet

Smoother flow and decreased oxygen pick up

Efficiency & Disc stack configuration

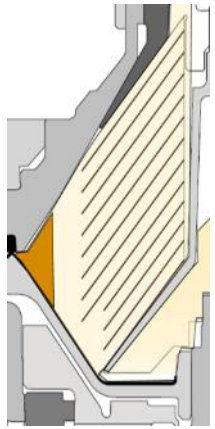
Steep disc angle (35º)

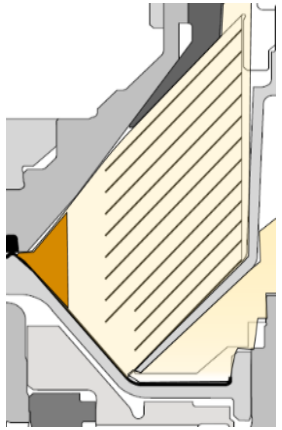
Shallow disc angle (40º)

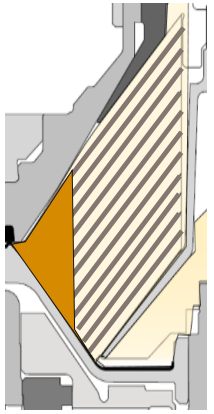
Steep disc angles – better separation
(polisher or hybrid configuration)

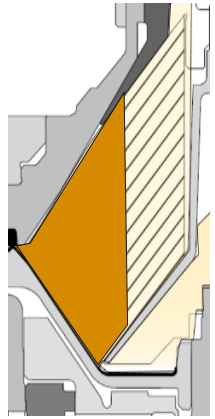
Hybrid configurations

Longer discs – better separation
Shorter discs – more solids space









Minimum beer oxidation

– Hermetic seals

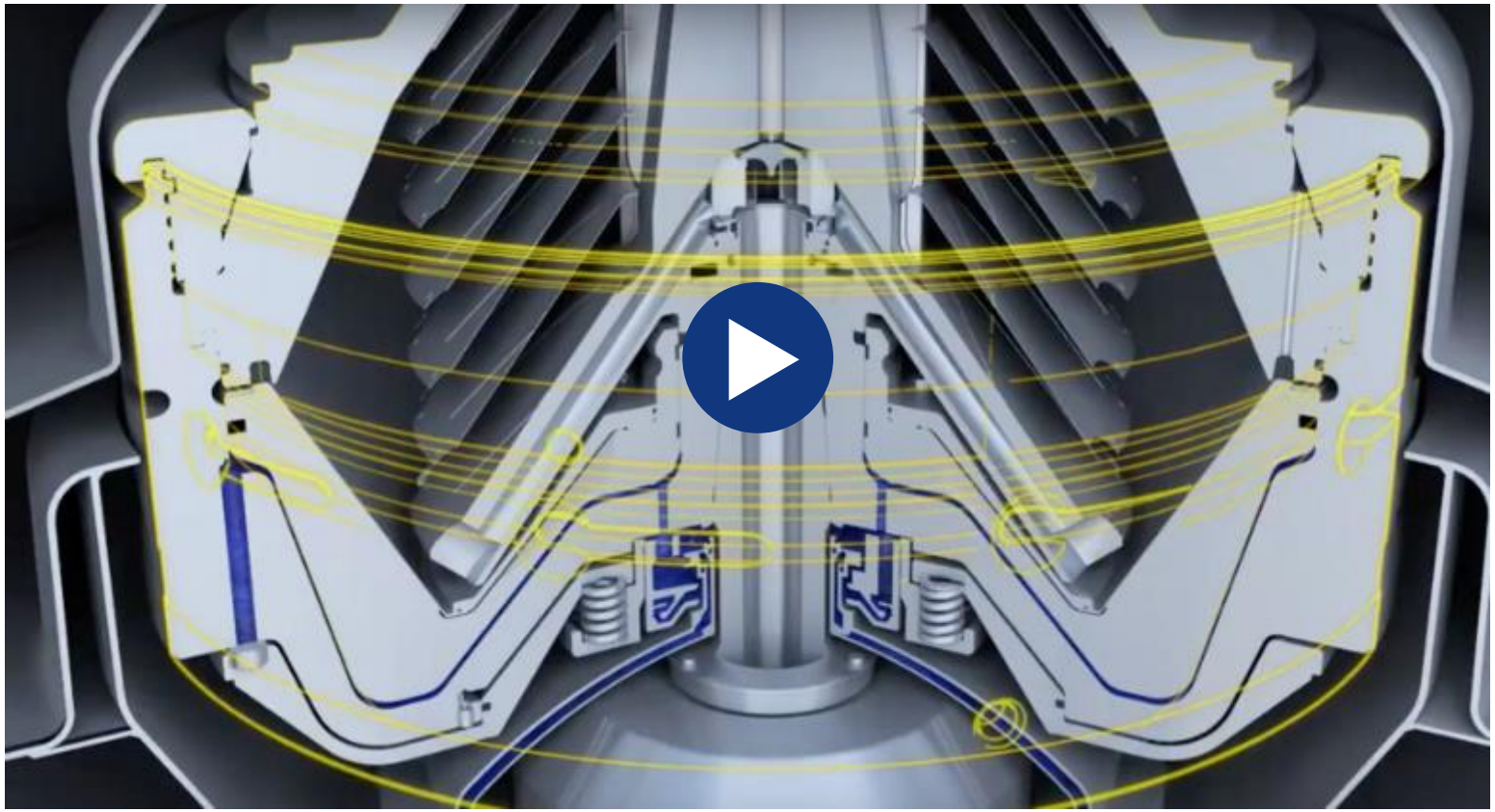
Less than 5-10 ppb
DO pick up between
inlet and outlet

Different seal arrangements
available in the market:

- Hydro-hermetic seal
- Axial Hermetic seal
- Double mechanical Seal

Beer clarification

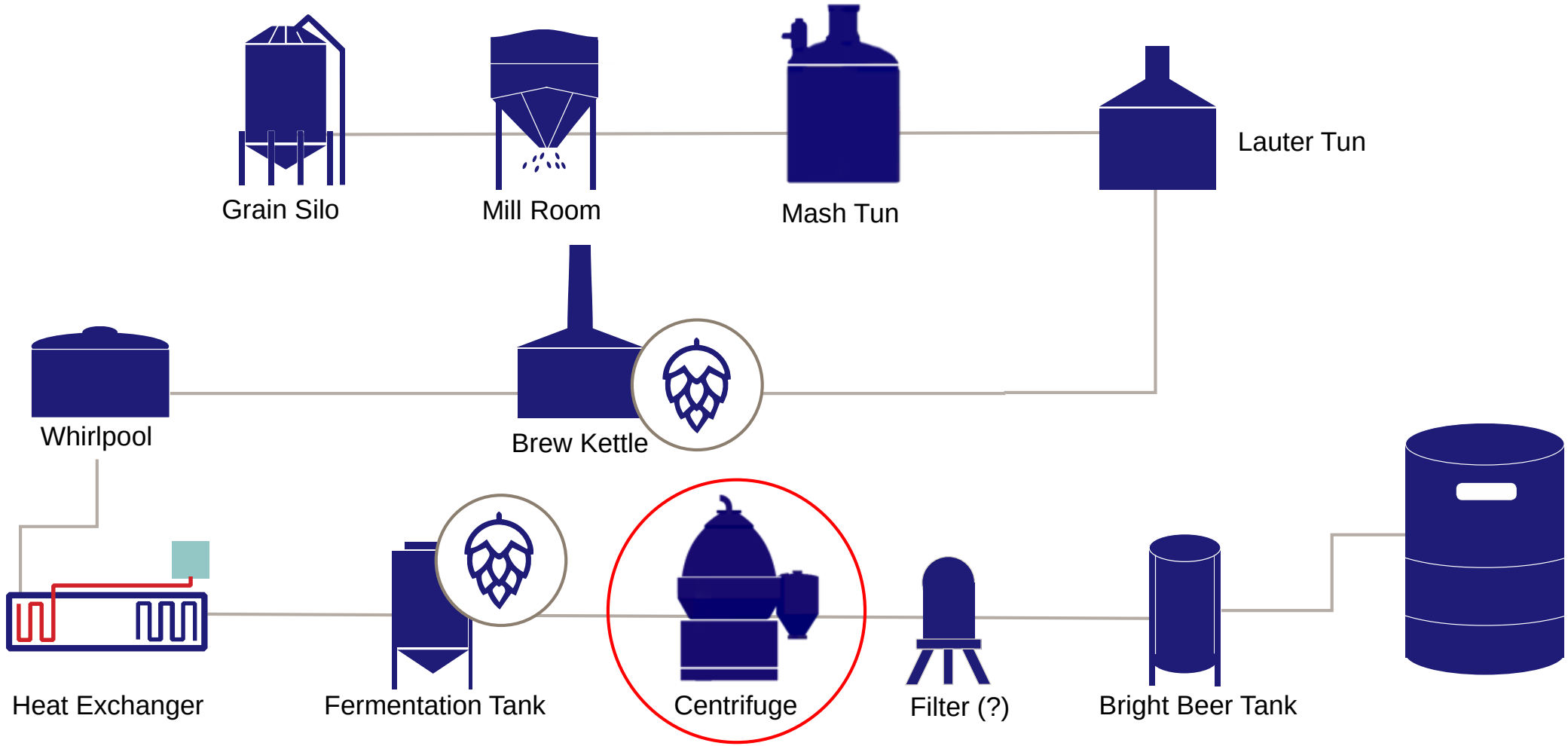
Solids removal from liquid phase



https://www.youtube.com/watch?v=SnApTQyl77U&t=0m19s

Brewing applications

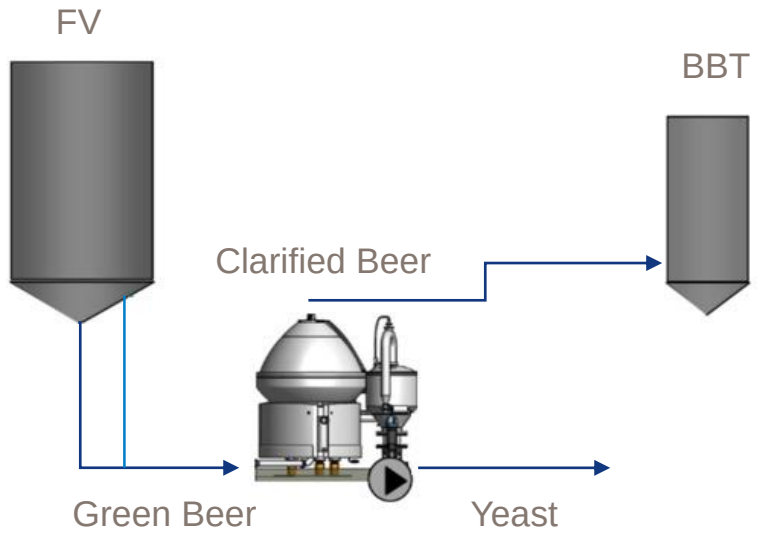
General Brewing Process Layout



Beer Clarification

– General beer clarification duty

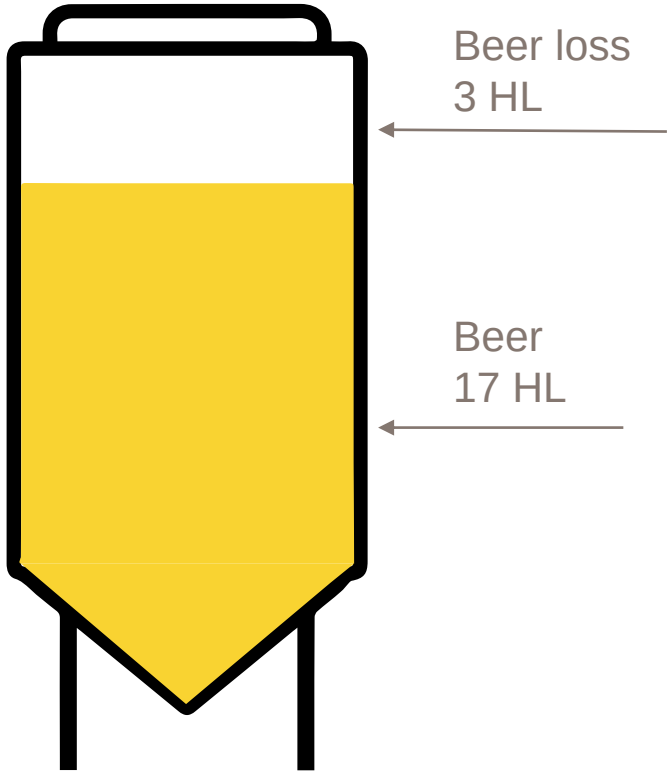
- Quick and efficient removal of yeast, hops and other coarse solids
- Earlier transfer of the beer
- Less time needed for cooling and settling of yeast and solids
- Less beer losses. Typically solids are ejected with dryness of 22-23% DM
- Defined yeast counts to maturation vessel or bright beer tank is possible
  - Consistent maturation
  - Secondary fermentation



More yield with the centrifuge

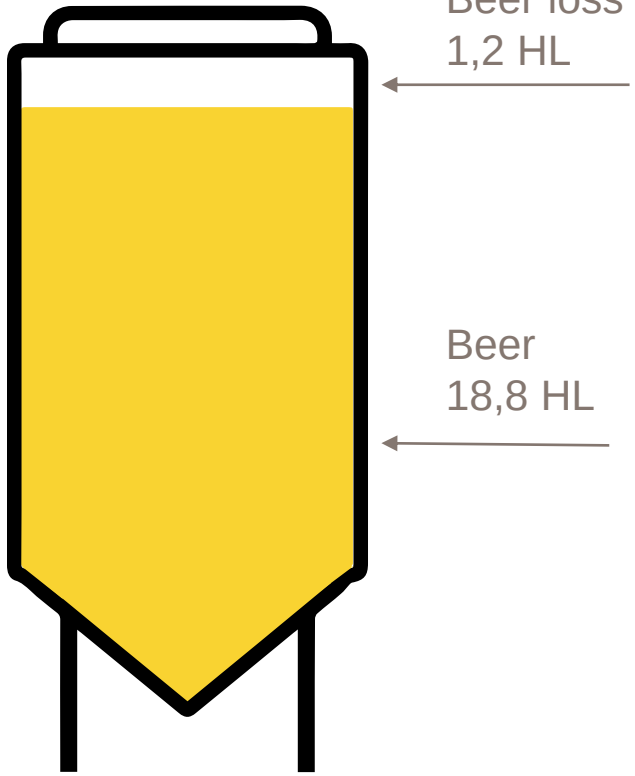
– Example from a customer brewing Hazy IPA styles with a high solids content

Without a centrifuge



FV – 20 HL

With a centrifuge



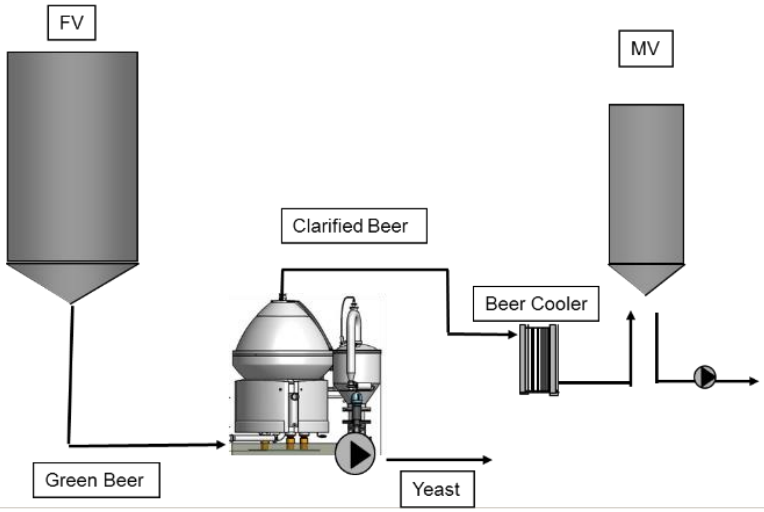
FV – 20 HL

~11%
more yield if using a centrifuge

Beer Polishing

– Features & Benefits

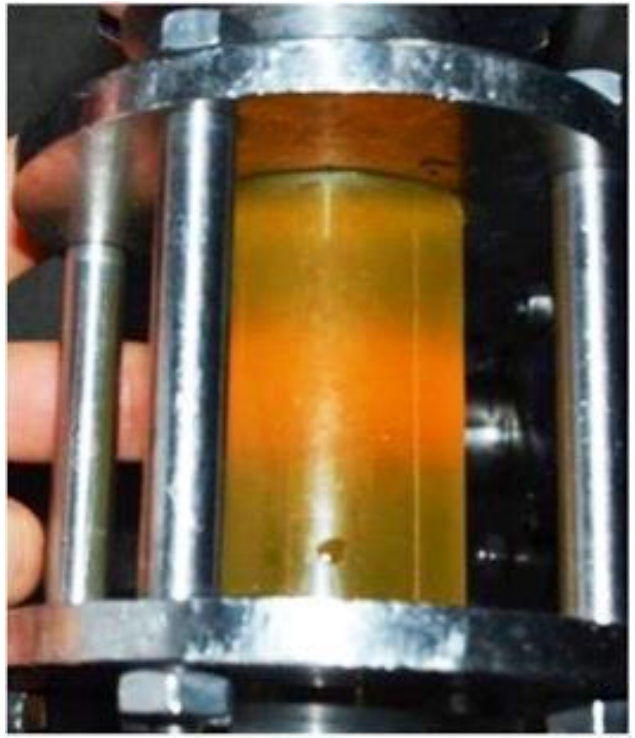
- Bright to near bright beer without filtering
- Possible to polish beer with all HSS
- Degree of polishing defined by flow rate



Polished beer & Hazy beer

- Bright to near bright beer styles without filtering
- Reduces the consumption of potential filter aids
- Controlling proteins and polyphenols in centrifuged beer
- Possibility to adjust desired final haze

Clarification vs Polishing



Clarifier type:
Removal of the bigger particles such as yeast or hop particles

Polisher type:
Removes smaller particles also reduces the chill haze

Flow rate

– Altering the flow rate has the largest effect on clarity

Flow rate
15 hL/hr

Flow rate
10 hL/hr

Flow rate
5 hL/hr

Brew 20
4-15 hl/h

Note

Inlet beer, left glass, has been clearing naturally in a tank for 1 month prior to centrifugation. Something that is uncommon for most breweries

Bowl Speed

– Variable speeds for variable clarity

- Flow Rate – primarily
  - Largest effect
- Bowl Speed – Secondarily
  - Final haze adjustment

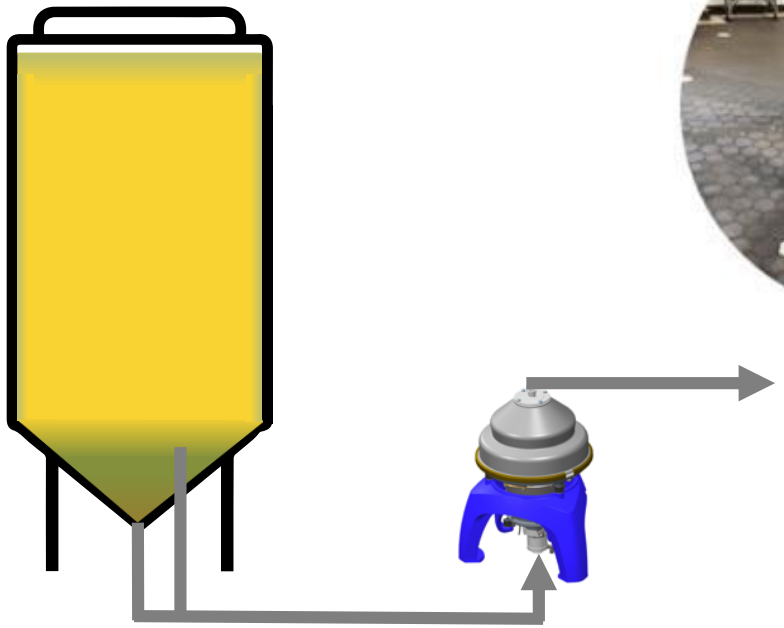
Brew 250 – West Coast IPA

- Flow rate: 35 hL/hr – 1kg hops / hL
  - 6200 rpm → 70 EBC
  - 5500 rpm → 110 EBC

Process improvements

– Racking cane or Stand pipe feed

- Feed from racking cane/stand pipe
  - Blending with tank bottoms



Complete Brew centrifuge systems
& Options

Complete separation systems

- Centrifuge
- Process and service liquid modules
- Control system
- Motor starter / VFD
- Skid mounted (or modularized)

- Options incl
  - Turbidity meter on the outlet for discharge triggering
  - Turbidity meter on the inlet for Inlet flow control

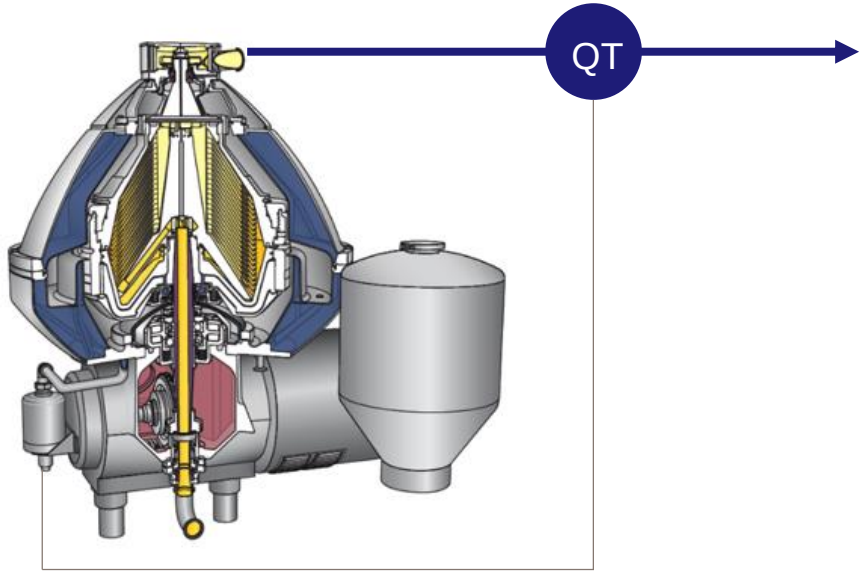
Complete separation systems

https://www.youtube.com/watch?v=ituGQnzAIKk

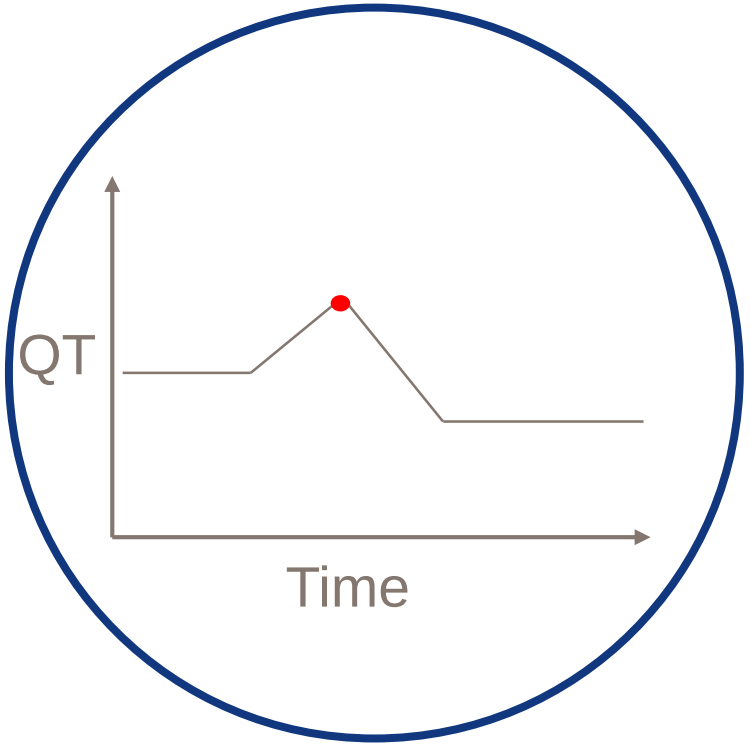
Turbidity discharge triggering

– Turbidity meter on the outlet for discharge triggering

- For varying feed solids load
- High outlet turbidity indicate full solids space
- Discharge triggered before disc stack is blocked



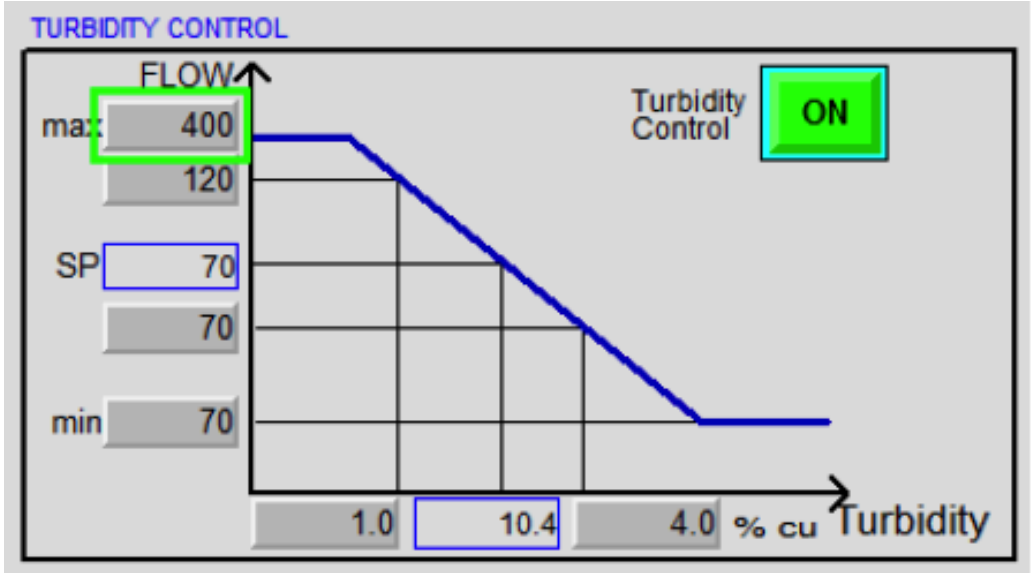
QT = Turbidity Transmitter

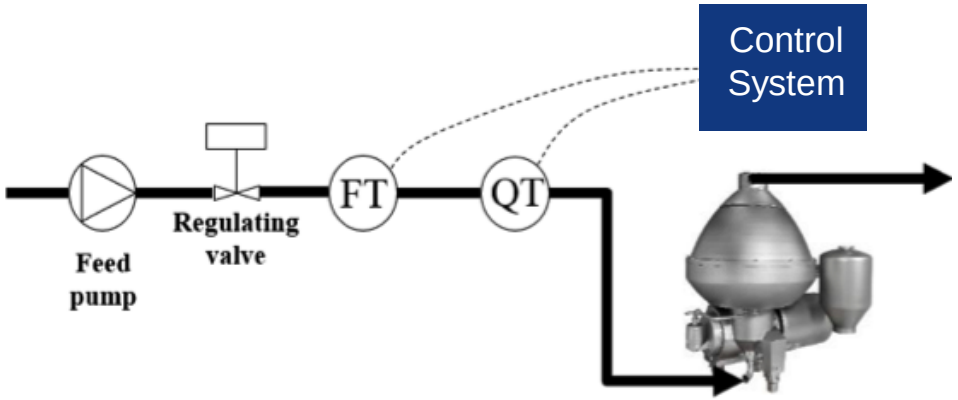


Capacity control

– Turbidity meter on the inlet for Inlet flow control

- In order to avoid bad separation due to too high feed rate
- To avoid overfilling the separator with solids





FT = Flow Transmitter
QT = Turbidity Transmitter

Alfa Laval Craft Brew portfolio

Brew 20 — Up to 15 hl/h

- High performance clarifier for capacities 4-15 hl/h
- Plug-and-play skid for simple operation and installation
- Low oxygen pick-up – Axial hermetic outlet

Brew 80 — Up to 50 hl/h

- High performance clarifier for capacities 10-50 hl/h
- Plug-and-play skid for simple operation and installation
- Low oxygen pick-up – Axial hermetic outlet

Brew 250 — Up to 180 hl/h

- High performance clarifier for capacities 10-180 hl/h
- Plug-and-play skid
- Center to center
- Zero oxygen pick-up and low power consumption

Centrifuge sizing example

– Turbidity meter functionality

- Size of fermentation vessel: 40 HL
- Average dry hopping rate: 500 g/hl
- Solids concentration: 3,0% v/v
- Required flow rate: 20 HL/h

General recommendation:

Brew 80

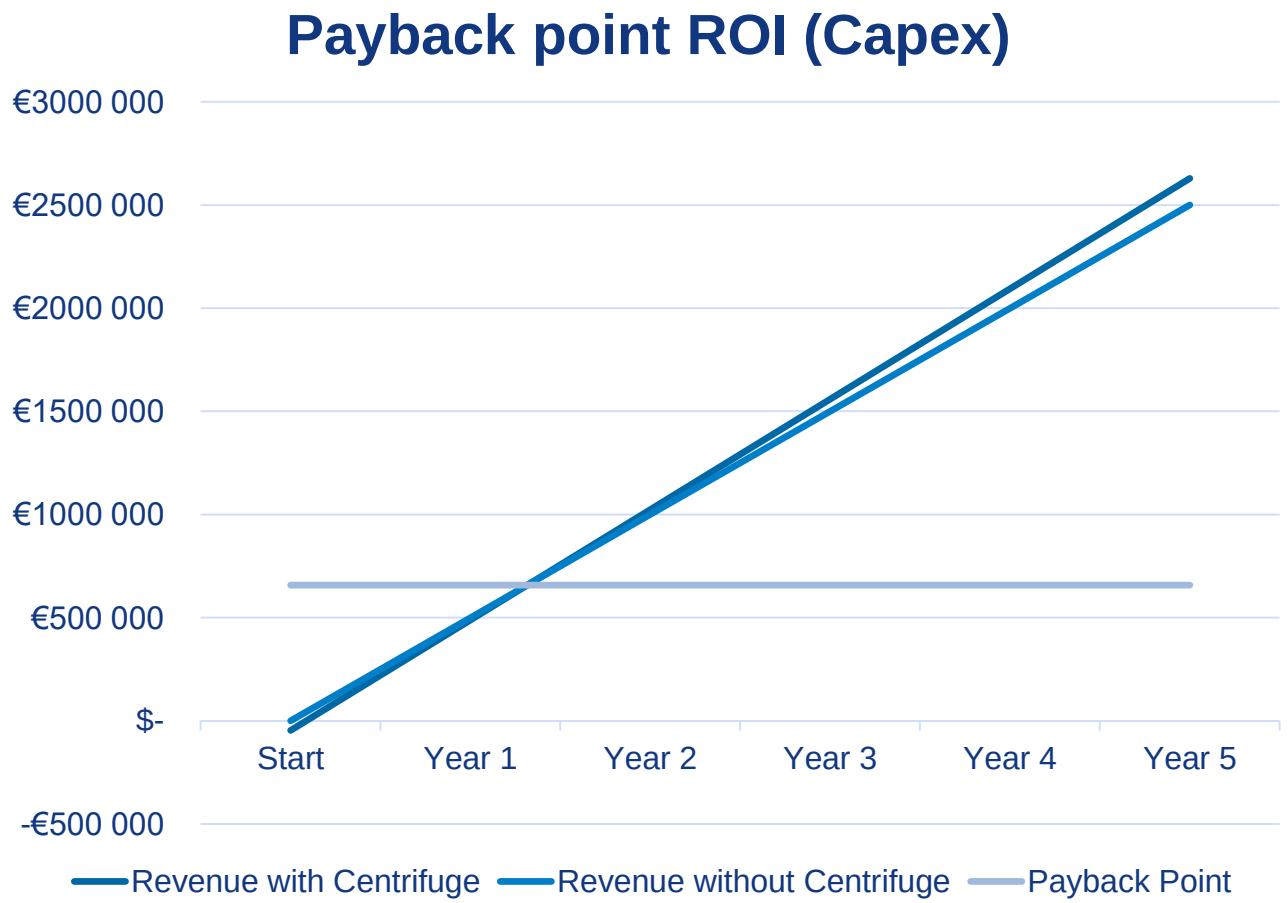
Return of investment example

– Based on yield increase only

- Fermentation vessel: 20 hL
- Yearly production: 2000 hL
- Suggested flow rate: 5-10 hL/hr
  - → **Brew 20**
- Recovery rate for IPAs – Yield increase ~ 8%

- Beer sales: €2,5/L
- Return of investment:
  - → **Less than 1,5 years**

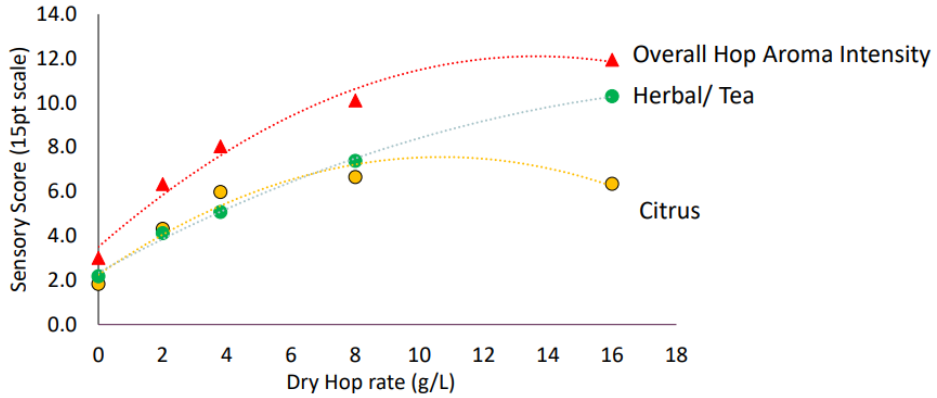
Beer and cider production



Hop Bite or Hop Burn

– Astringent hop flavors

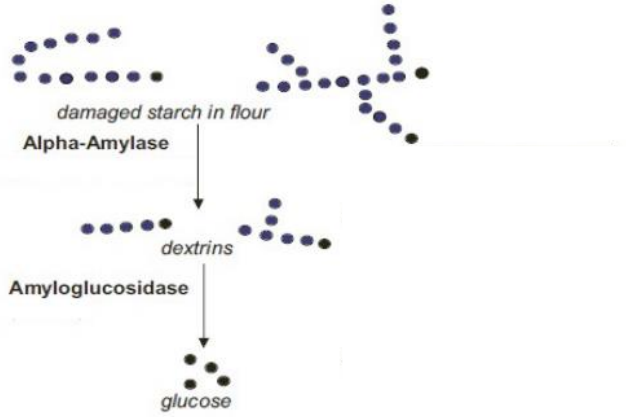
- High dry hopping rates
  - Diminishing returns
  - Increased bitterness
- Humulinone & polyphenols
- Longer conditioning required
  - Hop particles
  - Yeast adsorption
- CRYO Hops

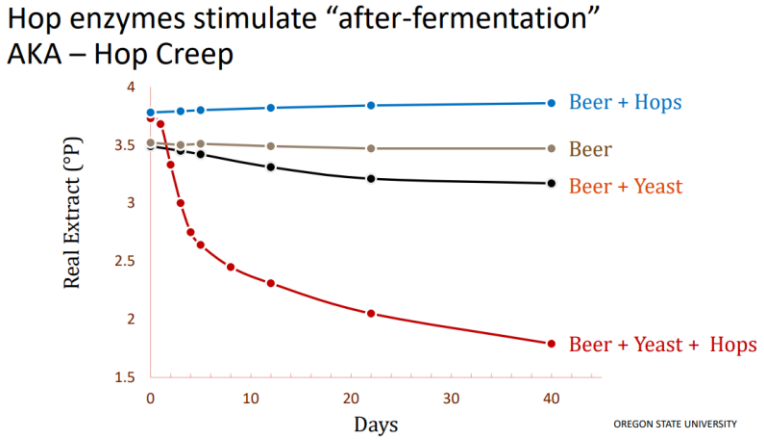


Dry Hop Creep

– VDKs after dry hopping

- Diacetyl formation after completed fermentation
  - Butter scotch flavors
- Diastase enzymes breaks down dextrins
- Possible to inhibit this by either removing hops or yeast or both



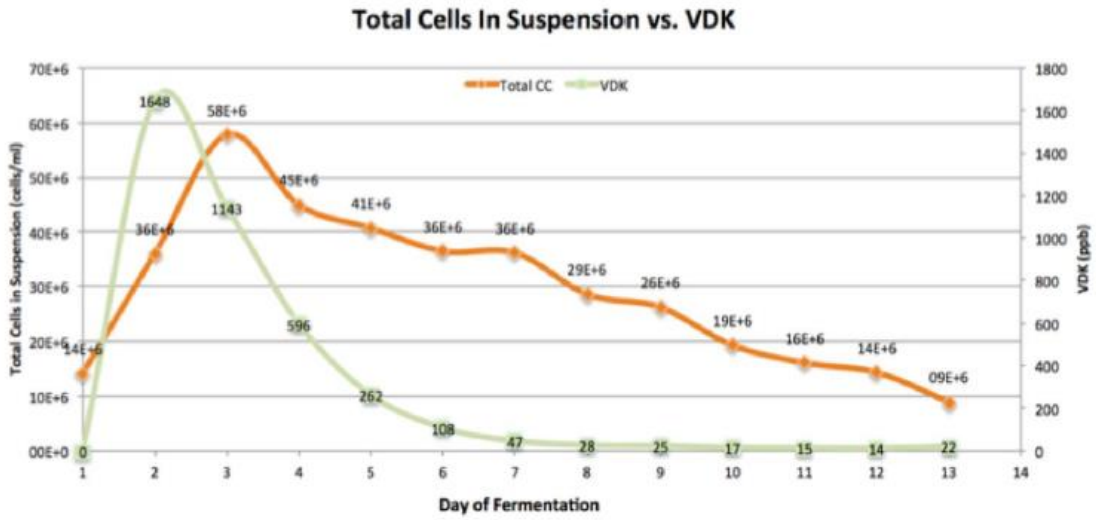


Dry Hop Creep

– pFriem test results

Most important variables to consider:

- Cells in Suspension
- Timing of Dry Hop
- Dry Hop Quantities
- Dry Hop Temperature
- Totaly Contact Times
- Agitiation or No Agitation



Centrifuges in breweries

– Summary

A centrifuge will contribute to:

- Clear beer with less or no filtering
- Quicker tank turn-over
- Beer recovery & reduced product loss
- Improved quality & consistency
- Improved filter performance
- Controlled haze in the beer

Eddyline Brewery

Mic Heynekamp, Founder

Brew 80

Colonial Brewing

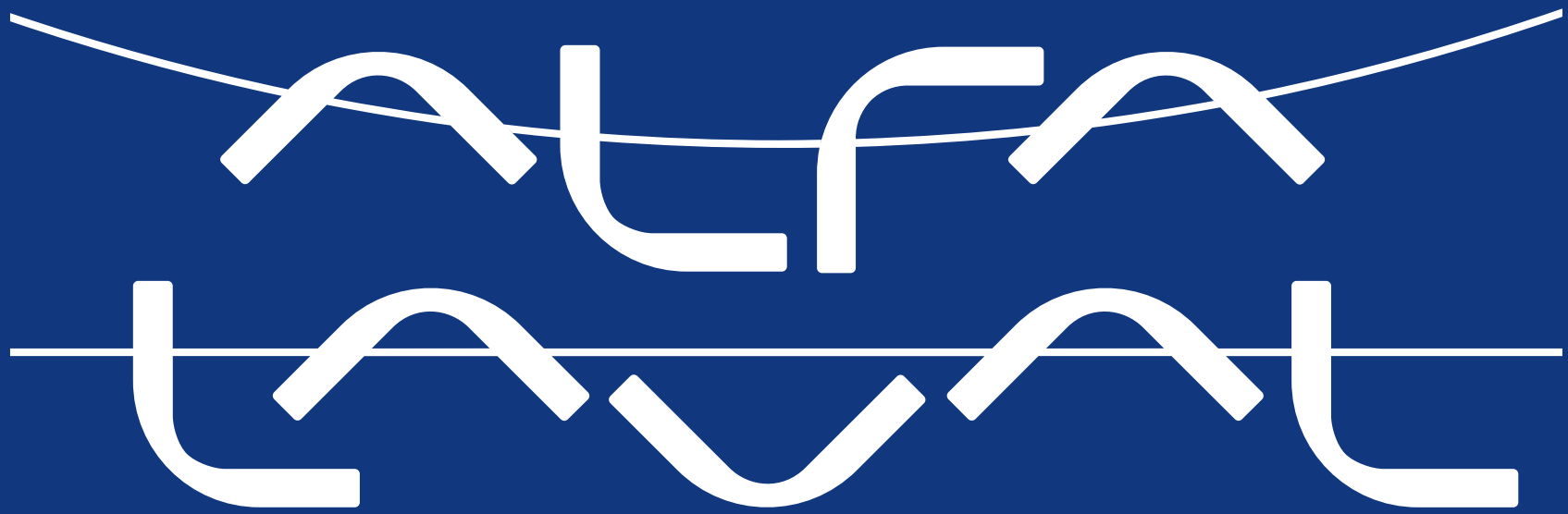
Ash Hazell, Head of Brewing

COLONIAL
BREWING Co

MARGARET RIVER W.A.
PORT MELBOURNE VIC

Brew 250

Q&A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